UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 735

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief

Washington, D. C. ▼ November 15, 1918

FARM PRACTICE IN GROWING SUGAR BEETS IN THE BILLINGS REGION OF MONTANA

By

S. B. NUCKOLS, Assistant Agriculturist, Office of Sugar-Plant Investigations, and E. L. CURRIER, Professor of Farm Management, Montana Agricultural College

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By S. B. Nuckols, *Assistant Agriculturist, Office of Sugar-Plant Investigations,* and E. L. Currier, *Professor of Farm Management, Montana Agricultural College.*

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BASIS OF THE STUDY.

To obtain data on methods of management, labor requirements, and cost of growing sugar-beets, studies were conducted on a large number of farms during the summer of 1916 in the area which grows beets for the beet-sugar factory at Billings, Mont., including farms

[1] This bulletin was prepared jointly by the Montana Agricultural Experiment Station and the Bureau of Plant Industry and with the approval of the Office of Farm Management. The blanks used in collecting these data were prepared in the Office of Farm Management, hence the material incorporated in this bulletin is identical in form with that in the other bulletins of this series prepared jointly by the Office of Farm Management and the Bureau of Plant Industry. The members of the staff of the Office of Farm Management were engaged in taking records in other localities at the time this work was done, and for that reason they are not represented in connection with the preparation of this bulletin.

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in the irrigated areas of Yellowstone, Stillwater, and Carbon Counties. Usable data were taken on 305 farms representing a sugar-beet crop of 8,849 acres, being about 36 per cent of the entire acreage grown for this factory during the year 1915. This acreage is generally distributed throughout the entire area and is believed to be typical of the region at the time the survey was made. The costs here given may not be accurate for present conditions. There have been, however, no changes in the methods of handling the crop tending to reduce the labor necessary to produce it; therefore, by readjustment to allow for prevailing labor prices these data can be applied to the present cost of production.

Records were taken on all types of farms of the area except such as seemed not typical of the region. A labor-income farm survey had been made of this region in 1915 by the same men who had charge of this survey. As the leases are for only one year and the owners often do not live in the region, data on many of the tenanted farms are hard to get, but records were obtained on 133 tenant farms, of which 77 were farms upon which the tenant had farmed but one year. After eliminating records of doubtful value, 305 records remain, on which the statements of this bulletin are based.

PROCEDURE.

The data presented in this bulletin, though not taken from systematic records kept on the farms, are based upon a large number of estimates given by beet growers. The results represent the best judgment and experience of men who have been actively engaged in the production of this crop. The schedules were filled out by well-trained enumerators and not only afforded complete information pertaining to farm practice and farm costs in the production of sugar beets but also furnished data showing the outcome of the entire business of the farm for the particular crop year to which they applied.

DESCRIPTION OF THE REGION STUDIED.

The portion of the Yellowstone Valley covered by this survey (fig. 1) consists of two parts, viz, the Huntley Irrigation Project and the irrigated area extending from Billings as far west as the town of Park City.

HUNTLEY IRRIGATION PROJECT.

The Huntley Irrigation Project occupies a strip of land along the south side of the Yellowstone River, from Huntley, Mont., eastward to Pompeys Pillar, a distance of about 22 miles. This strip of land has an average width of 3½ to 4 miles and comprises an area of 32,405 acres. This land was originally divided by the Government into

tracts containing 40 to 80 acres, but at present many of the units have been combined so as to form larger farm areas. The soils of this area contain a rather high percentage of clay and are inclined to be heavy and somewhat difficult to till.

For several years the lower portion of the project has suffered rather badly from the effects of seepage water and a consequent accumulation of alkali salts on the surface of the soil. An extensive drainage system is being installed, which will probably do a great deal toward relieving this condition.

The growing of sugar beets forms the basis for the agriculture of this region. Other important crops are alfalfa, wheat, oats, and barley.

AREA FROM BILLINGS WESTWARD.

The area in the Yellowstone Valley west of Billings comprises a strip of land extending from about 1 mile east of Billings to 1 mile west of Park City, a distance of nearly 25 miles. At Billings this area is about 4 miles wide, and it gradually widens toward the west until at a distance of about 8 miles west of Billings a maximum width of 7 miles is reached. It then narrows abruptly to about 3 miles, which width it approximately maintains to Park City. The area comprises 68,416 acres, or about 107 square miles. The soils of this area for the most part are inclined to be a little heavy, although they seem well adapted to the growth of sugar beets and other crops that are found in this region.

FIG. 1.—Outline map of the State of Montana, showing (in black) the approximate location of the sugar-beet region studied. The white dot in the black area indicates the location of the sugar-beet factory at Billings.

The considerable area of stock range adjoining the area has been an important factor in promoting the agriculture of this valley. On the whole, a well-balanced system of farming has developed, using beets as a cash crop and building around the beet crop a rotation of small grain and alfalfa.

This area as well as the Huntley project is irrigated by waters diverted from the Yellowstone Valley, the supply of which is more than ample for all purposes.

Clarks Fork Valley.—The Clarks Fork Valley occupies a strip of country along the Clarks Fork River about 50 miles long and varying

from 4 to 10 miles in width. The greater part of this area is irrigated from waters diverted from the Clarks Fork River and numerous smaller streams that have their origin in the mountains near by.

Soil conditions in this valley are very similar to those in the adjacent Yellowstone Valley, with the exception that the soils are perhaps a little less heavy and more easy to till.

The altitude of this valley is somewhat higher than that of the Yellowstone, making a shorter growing season and increasing a little the liabilty to frosts. Sugar beets are grown toward the lower end of the valley.

DEVELOPMENT OF THE SUGAR-BEET INDUSTRY IN THE BILLINGS REGION.

The sugar-beet industry has developed rather rapidly in the Billings region of Montana. The factory at Billings has been in operation since 1906. Before that time sugar beets were grown in the region only experimentally, to determine the advisability of establishing a sugar factory. Previous to the introduction of the sugar-beet industry the region was mainly devoted to cattle raising and grain growing. The acreage of irrigated land and consequently the acreage of tillable crops has been increasing in this region for a number of years. Table I illustrates the increase in the acreage of sugar beets grown in this region and gives the average yields per acre for a period of 10 years.

TABLE I.—*Acreage and yields of sugar beets in the Billings region for the 10-year period from 1906 to 1915, inclusive.*

Year.	Total area.	Yield per acre.	Year.	Total area.	Yield per acre.
	Acres.	*Tons.*		*Acres.*	*Tons.*
1906	6,184	9.47	1912	19,017	10.11
1907	8,898	10.75	1913	22,887	10.21
1908	9,457	12.22	1914	18,707	10.91
1909	10,365	10.71	1915	22,233	9.76
1910	10,251	11.76			
1911	15,694	11.56	Average	14,369	10.75

IRRIGATED AREA IN BEETS IN 1915.

Many farms have tillable land that is not irrigated and therefore not suitable for the growing of sugar beets. The computations in Table II are based on the irrigated lands per farm, exclusive of irrigated permanent pastures, as such pastures are often seeped lands or otherwise not suitable for growing sugar beets. Irrigated pasture lands which are in the rotation are included in the tabulation.

The fact that the acreage of beets grown by owners is less than that grown by tenants is not due so much to the size of the farms or to the

character of the lands as to the feeling of responsibility on the part of the owners for the future production from the farms. Landlords and tenants in this territory as a rule are not considering results beyond a 1-year period. Beets being a cash crop, the tenant can pay higher rents where the land is put to beets. Continuous cropping to sugar beets is practiced on tenant farms, and the fact that nearly 4 acres out of each 10 irrigated acres are in beets means that in some cases poor methods of rotation are in use and that ideal conditions exist for the introduction of beet diseases and beet insects. The solution of such problems is in the hands of the landlords and not the tenants, as the leases can be made so that the tenant will grow less beets and be able to practice a rotation of crops. Just what percentage of the irrigated tillable land should be planted to sugar beets is a matter to be decided for the individual farm.

Every farm should have a proper rotation of crops, but the type of soil and the other crops that can be grown have a great deal to do with the percentage of the total area that should be planted in beets. Previous to the introduction of sugar beets into this region there was no common cultivated crop that required summer tillage, the rotations being limited to alfalfa and small grains. Under these conditions many weeds that thrived with such a rotation became established in this region, and much land has been planted in beets in order to kill out these weeds. If continued growing of beets on the same lands is practiced no doubt insects and diseases of the beet will become established, which will necessitate rotation to do away with these pests.

The data collected would indicate that not over 25 per cent of the irrigated tillable area in this region should be planted to beets. This would permit the keeping of some live stock and provide a more substantial and well-balanced system of farming.

Grain and hay farming is not adapted to the needs of the man with a small farm who is trying to get sufficient returns from the farm to make a living for an ordinary-sized family. He must have crops that make a larger gross return per acre and give him a chance to use more labor. Many farms in this region have less than 40 acres of tillable land, and some of these farms have a large percentage of their tillable area planted to beets.

Table II also shows that a smaller percentage of the irrigated land on the larger farms is planted to beets than on the smaller farms. The acreage of beets per farm increases with the size of the irrigated area per farm, but not in proportion. This may be due to the desire on the part of each man to operate his farm with as little hired labor as possible; that is, there is a tendency toward the 1-man farm. On some of the smaller farms the operator has to grow intensive crops in order to occupy his entire time.

TABLE II.—*Classification of the 305 farms studied in the Billings region, according to ownership and size, showing the percentage relation between the total irrigated area and the area planted in sugar beets in 1915.*

Classification of farms.	Number of farms.	Irrigated crops (acres).				Percentage in beets.
		Total planted.		Average per farm.		
		Area.	In beets.	Area.	In beets.	
As to ownership:						
Owners	117	10,276	2,573	87.83	21.99	25.03
Owners renting additional acres	55	5,953	1,622	108.24	29.49	27.24
Tenants	133	12,132	4,654	91.21	34.98	38.36
All farms	305	28,363	8,849	92.99	29.01	31.20
As to size:						
25 acres and less	9	139	107	15.44	11.88	76.97
26 to 50 acres	77	2,844	1,273	36.94	16.53	44.76
51 to 75 acres	67	4,277	1,562	63.83	23.31	36.52
76 to 100 acres	45	3,845	1,357	85.44	30.15	35.29
101 to 125 acres	43	4,893	1,758	113.79	40.88	35.92
126 to 150 acres	28	3,919	1,121	139.96	40.04	28.60
151 to 175 acres	13	2,083	546	160.23	42.00	26.21
176 to 250 acres	14	3,001	653	214.35	46.64	21.75
251 acres and larger	9	3,362	472	373.55	52.44	14.04
All farms	305	28,363	8,849	92.99	29.01	31.20

PREVIOUS CROP.

Of the 8,849 acres of beets included in this survey, it was found that 6,129 acres were planted on land that had been in beets the previous year, 1,640 acres were on land that had been in alfalfa the previous year, 717 acres had been in grain the previous year, 86 acres had been in miscellaneous other crops, and data in regard to the previous crop, covering 277 acres, were wanting. This large acreage of beets planted on land that was in beets the previous year is an indication of a cropping system that should be modified by the growers as soon as possible if they do not wish to have decreasing yields of beets. Beets should not be planted on the same land continuously, even if the farmer has manure to put on the land each year. The figures given would indicate that nearly 70 per cent of the land was planted in beets at least two years in succession. Data for a longer period of time were not obtained, and it is not possible to state how long the average grower devotes land to beets without rotation.

On some farms certain fields are so located with respect to water supply and proximity to the loading dump, and have soil of so favorable a type that they are the most desirable parts of the farm for the growing of sugar beets. Naturally there is a tendency to plant beets on such fields for a number of years. This region having many tenants, no doubt much laxity exists in the planning of the crop rotation.

VALUE OF LABOR.

Throughout this bulletin the value of man labor is computed at 20 cents per hour, or $2 for a 10-hour day. Horse labor is valued at 10 cents per hour, or $1 per 10-hour day, whether the animal is worked single or in a 2-horse, 3-horse, or 4-horse team.

At certain times of the year labor may be rated higher than at other times, but the farmers were not able to give exact figures for different dates. Men were often hired by paying a definite sum per month for the entire year. Consideration was given to the variation in wages, and each grower was asked the highest and the lowest rate he paid for labor by the day or the month during the year. Data were also obtained as to the total time labor was hired and the total wages paid for each farm. Consideration was also given to the value of board furnished the laborers. Taking an average of all replies, it was found that the average wage was as stated above. The value of horse labor was ascertained by similar methods.

The cost of labor varied on different ranches, but in estimating the cost of production of beets for each farm the labor was rated at the average for the region. Family labor or labor done by the grower was figured at the same rate as hired labor.

MANURING PRACTICE.

As has been rather common in most western semiarid regions where the land was broken and planted to grain crops for several years, the farmers of this region have not placed a very high value upon barnyard manure. Manure has had a tendency to stimulate too heavy a growth of straw of the grain crops on these fertile lands. This attitude toward the use of manure soon disappears when the farmers begin to grow sugar beets. The feeding of stock has gradually increased on account of the manure produced, until now many of the sugar-beet growers state that without this by-product little profit would be found in the growing of sugar beets. The beet crop produces a great deal of stock feed in the form of tops, pulp, and waste molasses. Alfalfa hay grows well in this region, and this, with the grazing on range lands and the feed from the beets, furnishes the basis of an increasing feeding industry. It was reported that 36.7 per cent of the land planted to beets in the surveyed area had been manured at some time during the past three years. It was assumed that the manure would give beneficial results to crops for that length of time at least. The value of manures and the length of time over which the cost of application should be distributed were reported upon by all farmers, leaving little doubt as to the general sentiment in regard to the value of barnyard manures in the produc-

tion of a crop. The rainfall in this region is not heavy, and manures do not rot and become available plant food as rapidly as they do in more humid regions. In averaging the result of the numerous answers upon this point it was decided that the nearest correct method of distributing the cost of manuring was to charge 40 per cent to the first crop, 40 per cent to the second crop, and 20 per cent to the crop grown the third year after the manure was applied. Some men favored a longer period of distribution. That the manure on land was worth as much to the second crop as it was to the first was the almost unanimous opinion. As many farmers stated that the second year was better than the first as the reverse, the usual answer being that the two crops were equally helped. Considering this, the distribution stated above as to cost of manure and manuring seems to be justified. That is, on the land where beets were grown but one year after manuring, the charge would be 40 per cent of the value of the manure in the yard and 40 per cent of the cost of the labor of spreading the same. If the land had been manured for two years in succession before planting the beets, the charge would be 80 per cent of the yard value plus 80 per cent of the cost of application. If land had been manured for the three years previous to the growing of the 1915 crop of beets the charge would be 100 per cent of the cost of the manure and all the labor charges. The cost of manure and manuring was charged to every farm in this manner. Commercial fertilizers were not used, and the growing of special green-manure crops is almost unknown; however, a form of green-crop manuring exists. It is common to plow under alfalfa that has some green growth when being plowed. Most men who practiced this considered a green crop of alfalfa as beneficial as a 15-ton per acre coat of barnyard manure. Of the 1,640 acres of alfalfa broken and planted to sugar beets in 1915, a large part of it had some green growth at the time of plowing.

The value placed upon manures and the fact that commercial fertilizers are not used is easily explained when the character of the soil is taken into consideration. This is a soil that runs rather low in humus but relatively high in mineral nutrients.

Sugar-beet growers almost without exception used their total available manure upon the land to be planted immediately to beets. This might in part be due to the fact that no other cultivated crop is grown to any great extent by most of these men, but their opinion was that the manure was most readily available and most beneficial when applied to beets.

The methods of applying the manure varied, but most of the growers used wagons and forks. Only 98 growers used manure spreaders, while 207 used farm wagons. The manure is mostly

spread in the winter and early spring, and most men prefer to get manuring done when they have spare time. If the manure can be plowed under soon after it is spread, the spreader is the most successful method, but where manure is hauled to the field a long time before it is to be plowed under it is best to place it in small piles and spread it with a fork just before plowing. Spreading and disking under is often a better method than to pile the manure.

Either piling or disking the manure may cause a little more labor, but this method permits the work to be done at a time when teams are not busy, thus conserving the value of the manure by preventing its drying out and blowing away. To spread manure on the fields, leaving it exposed in this dry climate, entails a loss from the heavy winds that sometimes come in the early spring. That most farmers do their own work of spreading manure is indicated by the fact that on 62 per cent of the farms where manure was applied the spreading crew was one man and two horses and 69 per cent of the farmers used a 1-man crew.

It cost 27 cents per ton to distribute manure with one man to a wagon or spreader and a team of two or more horses; with two men to an outfit it cost 23 cents per ton, and with three men 20 cents. This variation in cost is due to at least two factors: (1) The larger crews were spreading a greater acreage, and (2) in most cases they used manure spreaders and did their work at a more rushed season. The man with little manure to spread does not usually use a spreader, and the man who uses a spreader prefers to spread the manure at a time when it can be plowed or disked under immediately.

One man with a 2-horse team did double the work per horse that was done by one man with a 4-horse team, the same being true of three men with 3-horse teams as compared with three men using 6-horse teams. This is perhaps due to the number of horses that stand idle while the manure is being loaded. A crew consisting of three men and six horses used two spreaders with a 3-horse team on each spreader. While two men and one 3-horse team were engaged in loading, the other man with his 3-horse team was spreading the manure. With three men, a 3-horse team, and two spreaders, two men loaded the spreaders and one man with the three horses spread the manure, switching the team from one spreader to the other. This appeared to be a very quick and efficient method, as one spreader was being loaded while the other was being unloaded.

A total of 49,570 tons of manure was spread on sugar-beet land in this region for the 1915 sugar-beet crop. At the estimated yard value of 85 cents per ton this would be worth $42,298, but according to the method of distributing the charge to the immediate crop after manure has been applied it was found that 79 per cent of this sum,

or $33,510, should be charged to the 1915 crop of sugar beets. It thus appears that the total charge against future crops is greater than the amount that is accumulated in the soil from previous years. If the entire amount of manure used had been spread upon all the sugar-beet land devoted to the 1915 crop, the average per acre would have been 5.6 tons; but some growers spread as high as 25 tons per acre, and the average of 15.3 tons was spread on each acre manured, thus leaving 4,599 acres of land with no manure to benefit the 1915 crop of beets.

The growers on 72 farms did not manure any of the land they put in beets, 62 growers manured less than 25 per cent of their beet area, 116 used manure for approximately 50 per cent of their beet area, and 55 manured 75 per cent or more of all the land they put in beets. The lands that were manured as a whole produced a good increase in the yield, and, after deducting the value of the manure at 85 cents per ton and the cost of the labor of spreading it, a net profit of $1.41 per acre, due to manuring, is shown for the entire area. (Table III.)

TABLE III.—*Use of manure as affecting yields of sugar beets in the Billings region.*

[The valuation of beets is that given by the growers.]

Classification.	Not manured.	Percentage of area devoted to beets upon which manure was used.			All farms.
		1 to 24½.	25 to 74½.	75 to 100.	
Area devoted to beets.....acres..	1,908	2,055	3,443	1,443	8,849
Beets produced.....tons..	18,835	20,328	38,183	17,855	95,201
Production per acre.....do....	9.87	9.89	11.09	12.37	10.76
Value of beets sold.....	$110,742	$124,006	$228,022	$107,211	$569,981
Value of beets per acre.....	58.04	60.37	66.24	74.29	64.45
Value of increase of crop per acre.....	.....	2.33	8.20	16.25	6.41

In considering the value of the increased yield per acre, the quality of the beets as well as the added tonnage should be considered.

In the comparison of those farms using no manure with those spreading manure on 75 per cent or more of their sugar-beet land, it was found that the estimate of 85 cents per ton for the value of manure in the yard was less than the actual value of the manure, for on this one crop the farmer received an average of $1 per ton for manure by increased crop production after deducting for all labor costs of spreading manure at the usual rates. (Table IV.) This shows that manure has a value, and the beet grower can not afford to let it waste.

TABLE IV.—*Returns to growers using no manure compared with returns to those manuring 75 per cent or more of their sugar-beet area in the Billings region.*

Crop treatment.	Number of farms.	Beet crop.			Returns for manure less the labor cost.
		Area.	Per acre.		
			Yield.	Value of the net increase.	
		Acres.	*Tons.*		
Manured	55	1,444	12.38	$16.10	$12.79
No manure	74	1,908	9.87		

Manure worth $3.79 was put on each acre manured. The cost of its application was $3.31, as it required 8.9 hours of man labor and 15.3 hours of horse labor.

Growers to the number of 233, or 75.7 per cent of the total, manured part of their beet land. They manured 3,250 acres, or 36.7 per cent of the total beet acreage, at some time in the 3-year period prior to the time of planting the 1915 beet crop. As already stated, the writers have assumed that manure is beneficial to the crop for at least three years succeeding its application.

The data showed that in this region the average established owner manured more land than the average tenant, because the tenants were unable to get long leases on the land. The difference in this respect was 17.2 per cent of the area planted to sugar beets. The data also showed that the owners made slightly heavier applications of manure to the land manured. In fact, most of the land manured on tenant holdings was on those farms where the landlord had encouraged the feeding of stock on the land by feeding all the hay which he received for rental. Some landlords were taking an interest in their farms and feeding their hay on the land, and some of the tenants were feeding with the landlord under agreements whereby the landlord advanced the money to finance the buying of feeding stock, and the tenant performed the labor of feeding, thus effecting an exchange of labor for the use of capital.

PLOWING PRACTICE.

The entire area planted to sugar beets was plowed during the preparation of the seed bed. This work was done at an average cost of $2.54 per acre, or an expenditure of 4.59 hours of man labor and 16.18 hours of horse labor. This does not include any labor of crowning alfalfa sod where such lands were crowned before they were plowed.

Almost all the plowing done in this region is done in the spring, as growers do not have time to harvest their beets and do much fall

plowing other than that required for winter wheat. Some crowning of alfalfa is done in the fall and early winter, but little other than alfalfa land is plowed before early spring. Only 23 growers out of a total of 305 did any fall plowing, and only 3 plowed all of their beet land in the fall. Most growers were of the opinion that fall plowing of land for beets was advisable, but generally there was no time for this work because the beet harvest and work on other crops demanded all the available man and horse labor.

The data presented show that the average team of three or four horses and a man will plow a little less than 2 acres of land per 10-hour day.

All the growers plow rather deep in preparing land for sugar beets, and they so plan the operation that the land can be leveled off well for irrigation. The usual depth of plowing is from 8 to 10 inches, some plowing a little shallower or a little deeper, according to the type of soil they have. Two-way plows are used by some, and it was found that they leave the land in better shape for irrigation than plows of other types, as no dead furrows are left in the field. They are not difficult to operate. Definite data as to the number of 2-way plows were not obtained, because in many instances the enumerators did not differentiate between sulky plows and 2-way plows.

The variation in cost for different crews in plowing seems to be more in the cost for man labor than for horse labor. This is due to the fact that with more horses to handle less time is required by the man per horse, while the horse can do about the same amount of labor regardless of the method of hitching. As has been explained in regard to the kind of plows used, the classification of crews might be limited to 2-horse teams, 3 or 4 horse teams, and 5 or 6 horse teams. The 3-horse team seems to have an advantage over the 4-horse team. Part of this may be due to the method of hitching and the facility of turning. A 3-horse team is hitched abreast, while four horses are hitched in two teams tandem in most instances. Most of the advantage is due to the type of soils. In the sections where the soil is more sandy and loose the plowing is almost all done by three horses, and in sections where the soil is heavier all the growers plow with 4-horse teams. The depth of plowing also influences the number of horses required for plowing.

Of the 15 growers who plowed with a crew of one man and two horses, 13 used walking plows, 1 used a sulky, and 1 did not state the kind of plow used. Of the 87 growers who employed 3-horse teams, 8 used walking plows, 77 sulky plows, and 2 gang plows. Of the 110 teams of four horses, 99 were with sulky plows and 11 with gang plows. Of the 17 teams of five horses, 3 were with sulky plows and 14 were with gang plows. Five growers hitched 6-horse teams

to gang plows. The remaining growers did not report the kind of plows used.

In considering the size of plows used, it was found that of the 310 plows reported 122 were 16-inch plows, 170 were 14-inch plows, and 18 were 12-inch plows. (Table V.)

TABLE V.—*Cost of plowing land for sugar beets with different plows in the Billings region in 1915.*

Kind of plow.	Area plowed.	Labor per acre.		
		Cost.	Man.	Horse.
	Acres.		*Hours.*	*Hours.*
Walking	272	$3.33	7.57	18.12
Sulky	6,396	3.10	5.61	19.74
Gang	1,319	1.94	2.85	13.67
Unknown	764	2.71	5.15	16.81
Hired	98	3.45	.....	.....
All farms	8,849	2.90	5.15	18.32

CROWNING ALFALFA SOD IN PREPARING LAND FOR BEETS.

Alfalfa crowning is done in the fall or spring when there is some green growth on the alfalfa plants, which when plowed under adds to the humus content of the soil.

A total area of 1,394 acres of alfalfa land was crowned for beet growing by 69 farmers. This labor takes about as much time as to plow the land. It requires 4.35 hours of man labor and 16.14 hours of horse labor to crown 1 acre, and the cost is figured at $2.48 per acre. If the work can not be done in the fall it is done as soon as possible in the spring, if the land is for beets that year. The plowing is to a depth of 3 or 4 inches, which is sufficient to cut off and turn over most of the alfalfa plants. The ground is then harrowed. The exposed alfalfa roots and crowns soon dry out and die, while if plowed to a greater depth many of them would sprout up again. After allowing the roots to dry out for a few weeks the land is plowed again to a greater depth, with the result that few of the crowns then turned under grow again. This method of handling alfalfa sod is much better than plowing only once, as it makes a better seed bed and does away with much volunteer alfalfa, which would make beet cultivation very difficult; also not so many roots are left on top of the ground to clog the cultivating machinery. The cost of the extra work of crowning is easily saved in the later work of thinning and cultivating the beet crop. Most of the growers prefer to crown in the fall if other work permits, so as to let the crowns dry out over winter before turning them under; in actual practice, however, few of them were able to do much alfalfa crowning in the fall. Of the total of 1,640 acres of alfalfa broken and planted in beets, 1,394 acres were

double plowed (or crowned and plowed) and 246 acres were plowed but once. Of the 1,394 acres crowned and plowed, 309 acres were crowned in the fall and 1,085 acres crowned in the spring. More of this crowning would have been done in the fall if the farmer could have found time to do it at that season of the year.

The crowning of the alfalfa sod is done with the same plows that are used to plow the land, and the time per acre for various crews runs similar to that required for plowing. The explanation of the variation in costs of plowing under varying conditions applies also to crowning alfalfa, the reasons being identical.

DISKING PRACTICE.

Disking was not a general practice in this region in 1915, as is shown by the fact that only 26.9 per cent of the farmers disked any land, and only about 21 per cent of the total area was disked. The plowing table shows that most of the land was plowed. Where disking was done, it was mostly by men who were preparing alfalfa land for beets. Some growers disked manured land before plowing.

Of the 82 growers who used the disk in preparing beet land, it was found that 7 used 12-disk implements, 40 used the 14-disk size, and 28 used 16-disk machines. The remaining 7 made no report as to the size of disk used.

Averaging all the farms, it is found that one man with the average number of horses (about four) can double disk 5.4 acres in a 10-hour day. A small number of farms use other than 4-horse teams for disking, so that a comparison of the cost by crews does not indicate much of practical value. The average acre disked required 1.84 hours of man labor and 7.19 hours of horse labor. This was applied at an average cost of $1.09 per acre for the 1,874 acres disked on 82 farms.

FLOATING PRACTICE.

The implement used in the operation of floating land is usually a homemade piece of machinery made from sawed timbers 2 or 3 inches thick and 12 inches wide; the length varies from 12 to 24 feet and the width from 6 to 14 feet. (Fig. 2.) Of the total number reporting, 50 per cent reported 16 feet as the length of the float, and most of those remaining were more than 16 feet in length. As to width, 20 used 6-foot floats, 12 used 7-foot widths, 89 used 8-foot widths, 33 used 10-foot widths, and 14 used floats wider than 10 feet. The pieces are bolted together so that the planks have only one edge touching the ground when in use. The three crosspieces usually provided serve to drag down the higher places in the field and deposit dirt in the depressions. This is an excellent implement for getting ground in level condition, so as to irrigate well. The longer floats

do good work in leveling where depressions are wide. A narrow implement will have a tendency to scoop out these places. Four or more horses are needed to handle a large float properly, the average number for the region being a little more than four. The number of horses needed and the efficiency of operation depend upon the size and weight of the float. Some lighter material is commonly used on top of the implement in order that the driver may ride standing or move about, so as to make the leveling more nearly perfect.

Practically all the growers in the region used some such machine, a total of 8,580 acres (nearly 97 per cent of the area planted to beets) being thus prepared.

The growers who did not use a box level of this sort used a drag made of overlapping planks. These drags are usually from 3 to 5

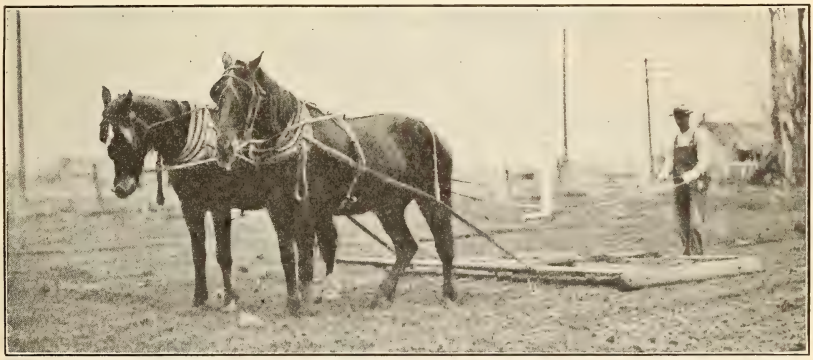

FIG. 2.—Floating sugar-beet land. The homemade implement here shown is used after disking to level the ground and put it into good condition for irrigation.

feet wide and 8 or 10 feet long. The drag is not considered so efficient an implement for leveling land as a level; the work it does is not so thorough. The drag is a somewhat less expensive implement to make and to operate and it requires less horsepower. The average cost for the 325 acres dragged was 66 cents per acre.

The average acre of land included under the survey was floated 1.82 times at an average cost of 89 cents per acre. This is the equivalent of 1.51 hours of man labor and 5.96 hours of horse labor. One man with a 4-horse team can float about 12 acres per day. The average cost is 49 cents per acre, or 0.83 hour of man labor and 3.27 hours of horse labor, to go over an acre once with a float.

Of the farmers who floated their land, 70 per cent went over it twice, 22 per cent floated only once, and the other 8 per cent floated more than twice. In floating twice it is the common custom to float both ways of the field.

Of the 302 growers who floated their land, 205 used 4-horse teams. The cost of floating with crews of different sizes can not be used for any practical application, for the men using the greater number of horses invariably have the heavier floats. These heavier floats usually accomplish more in the way of smoothing and firming the seed bed than the lighter floats for an equal number of operations.

HARROWING PRACTICE.

It required an average of 1.75 hours of man labor and 5.75 hours of horse labor to harrow an acre. All of the farmers harrowed their land in preparing the seed bed for beets; 246 growers used 2-section harrows, and 49 used 3-section harrows, while 13 used harrows of unclassified types. (Fig. 3.)

FIG. 3.—A 4-horse team harrowing a field of sugar beets. This crew economizes man labor.

Of the total number of growers, 31 harrowed their land but once, 158 harrowed twice, 70 harrowed 3 times, 34 harrowed 4 times, 4 harrowed 5 times, 4 harrowed 6 times, 2 harrowed 7 times, and 1 harrowed 10 times. The average field was harrowed 2.44 times, at an average cost of 38 cents per acre, or a total cost of 93 cents per acre.

Harrowing varied a great deal on the various farms, owing to two causes. The type of soil has a great deal to do with the number of harrowings that are necessary, and in this region the growers who use disks, drags, and levels do not use the harrow so much as those who have less machinery of this sort and who use the harrow as a sort of float or level by turning the teeth horizontal to the surface of the ground. The first harrowing of the land is usually done immediately after plowing. A man will harrow once what is plowed

each day, so as to prevent rapid drying out and the formation of hard clods. As a rule, this is done by the same man who does the plowing by switching from the plow and using the harrow for a time each day. A few men attach small narrow harrows to their plows. The practice of harrowing the land as soon as it is plowed is an efficient one, as much good can be accomplished with the harrow at that time.

Spring-tooth harrows are not used to any great extent in this region, as is shown by the fact that only 103 acres of land were harrowed with these implements. Most men who use a spring-tooth harrow use it in place of a disk. One man with a 4-horse team was the crew mostly used in spring-tooth harrowing, and the cost per acre to do this work averages $1.05 per acre harrowed, or 5.7 acres per 10-hour day for a crew of one man and four horses.

ROLLING PRACTICE.

The practice of rolling land before planting the beet seed is not general in this region, as is shown by the fact that only 27.8 per cent of the 305 farmers visited reported rolling land before planting, and less than 21 per cent of the total area planted to beets was rolled before planting. This might vary somewhat with different seasons, as rolling to firm the land for a good seed bed would be necessary in some years and not in others; however, in this region there is seldom much trouble with lack of firmness in seed beds for beets. Rolling is usually done to break clods.

The average 10-hour day's work at rolling by one man with a 2-horse team covers almost 14 acres of land; hence to roll 1 acre of land requires an average of 0.71 hour of man labor and 1.49 hours of horse labor.

Of the 84 men reporting the use of rollers, 50 used 10-foot rollers, 25 used 8-foot rollers, 6 used 12-foot rollers, and 3 used rollers less than 8 feet long. Data were not obtained as to the number of smooth and of corrugated rollers.

Of the 84 men using rollers, 80 hitched two horses to the roller; and the average man rolled his land 1.13 times, at a cost of 29 cents per acre.

DITCHING PRACTICE.

The cost of maintaining the small laterals, including the work of cleaning them out and the making of such new small ditches as may be necessary for the distribution of the water in the field so that it can be run into the furrows between the rows of beets, is only 13 cents per acre. This required 0.32 hour of man labor and 0.61 hour of

horse labor. The factors that affect the cost are the distance from the main lateral or ditch, the size of the fields, and the lay of the land. Some teamwork is used in plowing out ditches, but they must be cleaned out with shovels. A total of 8,666 acres was considered in the above as having a separate cost for ditch cleaning, six farms being so located that no extra work was required to get water to the beet field. This is a part of the cost of irrigation. Very few growers had any special tools for ditching, and they used common walking plows for plowing out ditches. A few had listers; others used homemade V drags.

In taking the records no separate accounting of the man labor and the horse labor was made, so no estimate can be given as to the hand labor done with shovels in cleaning out the ditches.

As already stated, the ditch cleaning is very variable, according to the type of ditches necessary to get water to each farm, and no comparison can be made as to the efficiency of the methods used by the individual farmers. Some seem to use more efficient tools than others, but as a general rule this work is governed by the lay of the land. More work is necessary in some years than in others, and a part of this work is sometimes more in the nature of a permanent improvement.

PLANTING BEET SEED.

Of the total of 305 growers in this region all but 3 used drills drawn by two horses each that planted four rows at a time. The other drills planted only two rows at a time. With a 4-row drill, the average area planted per 10-hour day was a little over 10 acres. Planting in this region begins as early as possible in the spring, sometimes the early part of April, and lasts until about the first of June. Early-planted beets seem to do better than those planted later, but the time necessary to prepare the land does not always permit early planting. Where the field is very large it is the custom to plant at different times, so that the thinning will be distributed over a longer period. It is not advisable to let the beets stand too long before thinning.

The most of the acreage in this area is planted in rows 20 inches apart. A few men planted rows 18 and 22 inches apart, so that it was possible to make a deeper irrigation ditch between the wide rows and irrigate only between alternate pairs of rows. This custom is not very common in this region, as the soil is heavy and water does not quickly soak across the rows where the furrows are very far apart. Also the land in most instances has a good slope for irrigation, and there is no need of a deep furrow or large head of water for irrigating between the rows of sugar beets.

It cost 40 cents per acre to plant beet seed, or one hour of man labor and two hours of horse labor.

ROLLING LAND AFTER BEETS ARE PLANTED.

After being planted, 4,935 acres, or 56 per cent of the total area in beets, was rolled. This rolling is usually done after the beets have come through the ground and before they have grown very much. It cost 31 cents to roll an acre of beets, or 0.77 of an hour of man labor and 1.55 hours of horse labor. Rolling is done for two purposes: (1) To break any crust that may have formed on the ground and enable many beets to come up that would not otherwise be able to get through, and (2) to break and crush clods that would be likely to be thrown on the beet row at the first cultivation. Most growers use corrugated rollers run crosswise of the beet rows. (Fig. 4.) Very few use smooth rollers, as they are not as efficient for breaking

FIG. 4.—A corrugated roller used on beet land. A good type of roller for firming the seed bed.

a crust on the land. Some growers rolled the beets after they were blocked and thinned, so as to firm down and level the soil and aid in cultivating.

By far the greater number of growers use only two horses in rolling beets. One man with two horses can roll an average of 13 acres of land per 10-hour day.

After the seed was planted, 178 of the men rolled a part of their beet land, and only 27 of these rolled the land more than once.

More rolling is done in some years than in others, because there is much variation in the seasons; for example, should a heavy rain occur between the time of planting the beet seeds and their germina-

tion, a heavy crust is likely to form on the ground and the small plants are unable to break through, which necessitates rolling to break the crust. If the ground is cloddy, the rolling should be done before the seed is planted, as beets never give the best results where there is lack of care in the preparation of the seed bed. Getting the young plants well started early in the spring is one of the essentials of a good tonnage of sugar beets. Rolling does not seem to damage the plants to any great extent, as they do not break off easily and the small leaves are not often crushed.

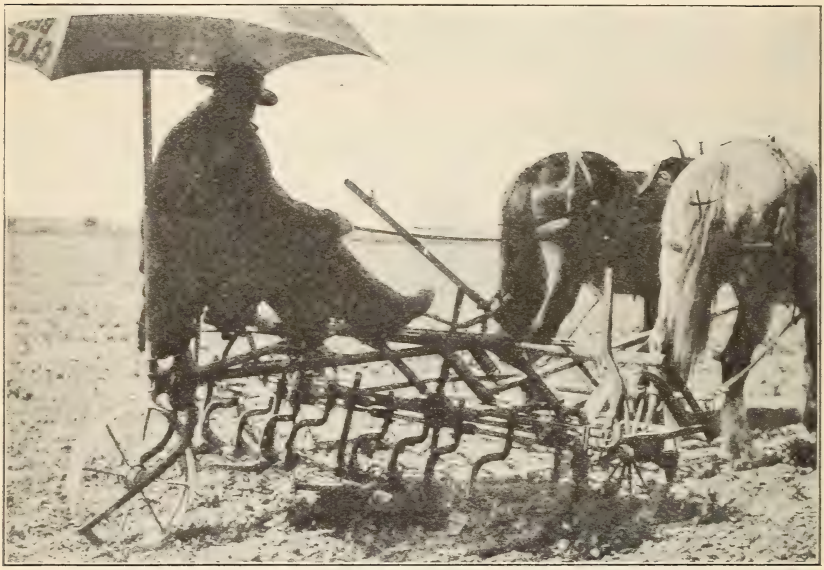

FIG. 5.—Cultivating sugar beets with a 4-row cultivator, which will do twice as much work as a 2-row machine, with practically the same amount of man labor and horse labor.

CULTIVATION OF BEETS.

Cultivation starts as soon as the beets are well through the ground and continues during the season at short intervals until the beets are so large that they shade most of the ground and one can not get through the rows without breaking the leaves. In early cultivations the work must be done slowly and carefully, as the beets are very small and there is danger of covering them with dirt. Knives or duck feet are used for the first cultivation, or both are used by attaching the duck feet behind the knives. (Fig. 5.) In later cultivations larger shovels are used, and the work can be done more rapidly than in the earlier cultivations. In the first cultivations the ground should

be loosened to a good depth. If possible, shovels should be run in the middle between the rows, for if this strip of ground is allowed to get hard satisfactory cultivation will be difficult. Early deep cultivations, if not too close, do not disturb any of the beet roots, while late, deep cultivations are apt to injure the beet roots. As much care should be taken to avoid injury to the roots of the beet as to the tops, for both roots and tops are essential to the growth of the plants. The first root of a beet strikes down deep into the soil and the side roots spread out later.

The cultivation of beets is in most instances done by 2-horse cultivators, which till four rows at a time; 37 growers used 1-horse cultivators that worked only two rows at a time. These 2-row cultivators are not as efficient as the 4-row implements, as they take about twice the man labor per acre, and the horse labor is about the same as for the 4-row machine. It takes two hours for a man to cultivate 1 acre with a 2-row cultivator and only one hour with a 4-row implement. Cultivators of the 2-row type are not used on large areas, as is shown by the average acreage of beets of those using 1-horse cultivators being only 14.5 acres per farm, while the average for those using 2-horse cultivators is 31 acres per farm. (Table VI.)

TABLE VI.—*Relation of the number of cultivations of the sugar-beet crop to the cost of labor in the Billings region in 1915.*

Cultivated.	Number of farms.	Acres of beets.	Percentage of total area.	Average labor cost per acre.[1]	Cultivated.	Number of farms.	Acres of beets.	Percentage of total area.	Average labor cost per acre.[1]
2 times...	12	372	4.2	$0.79	6 times...	13	614	6.9	$2.23
3 times...	86	1,964	22.2	1.28	7 times...	9	288	3.3	2.81
4 times...	125	4,183	47.3	1.68					
5 times...	60	1,422	16.1	2.20	All farms.	305	8,843	100.0	1.74

[1] The cost of the labor for furrowing, which is usually done once each season and by some is considered a cultivation, is not here included.

There is no clear indication that the number of cultivations had any great effect on the yield of beets per acre, there being many factors that might tend to cause a variation in yield; for example, the ground in certain fields may be in poor condition or the beets may not be doing well, and such a field will receive extra cultivations, while a good field may not be cultivated so often. Weedy land will be cultivated more often than fields that are comparatively free from weeds. Beets that are growing rapidly and are healthy and vigorous have a shorter season for cultivation before they become too large, but such beets usually yield best.

It required 4.46 hours of man labor and 8.46 hours of horse labor to cultivate an acre of beets an average of 4.09 times. (Table VII.)

TABLE VII.—*Relation of crew labor to the cost of cultivating the sugar-beet crop in the Billings region in 1915.*

Crew.	Number of farms.	Acres of beets.	Average times cultivated.	Cost of cultivating per acre.	
				Once over.	Total.
1 man, 1 horse	37	537	3.63	$0.60	$2.19
1 man, 2 horses	265	8,206	4.19	.41	1.71
Hired	3	98	3.41	.50	1.70
All farms	305	8,841	4.41	.42	1.74

FURROWING FOR IRRIGATION.

To furrow the average acre requires one hour of man labor, and the team or horse labor is nearly two hours, being a little less than double the amount of man labor because some men use only one horse for furrowing. The average cost of labor for furrowing is 39 cents per acre. Only seven growers furrowed twice, and only one did not furrow, the others furrowing once.

The ordinary beet cultivator is used for furrowing, shovels that make small ditches about 3 or 4 inches deep being attached.

Implements covering two rows were used by 35 growers; 12 furrowed five rows at a time, one man did not furrow, and the remainder four rows at a time. The furrower makes one extra ditch each time across, but doubles back in it in cases where two or four rows are furrowed at a time. Those growers who used 2-row furrowers did not have very large acreages of beets, averaging only 6 acres per man. Their acreage being small, it probably would not pay them to buy more expensive machinery. They furrowed on an average 5.77 acres per 10-hour day at a cost of 52 cents per acre, this being 13 cents per acre more than the average cost for the entire area.

In furrowing four rows at a time the average day's work of a man and 2-horse team for a 10-hour day was 10.72 acres, at a cost of 37 cents per acre.

In furrowing five rows at a time the man and 2-horse team averaged 12.71 acres per 10-hour day, at a cost of 31 cents per acre. Although this is the least in cost per acre for furrowing, it is very doubtful whether it is the most economical method. It is necessary that more care be taken to cover all the rows in the same order, as they are planted by a 4-row drill. If the rows are a little wide or close between drill rounds, this method will plow up some beets; and 6 cents per acre is a small saving, as a few beets will more than amount to this sum. A dozen beets plowed out or covered per acre would eliminate any saving, regardless of other losses.

IRRIGATING THE SUGAR-BEET CROP.

Irrigation in the Billings region is by water supplied directly from the river to the farms and not stored in reservoirs, such as are found in many sections elsewhere. The supply is from the Yellowstone River and its tributaries, and much of the water is available in June and early July, as this is the time when the water in the river from the melting snows of the mountains at the headwaters of the Yellowstone River reaches its highest point. Large ditches are constructed to take the water from the river, and these ditches run at an altitude higher than the lands to be irrigated. By a gradual branching into smaller ditches the water is distributed to the beet fields, where it is run in small furrows between the beet rows.

In running the water through the furrows between the rows of beets it is necessary to have only a small head, as it is advisable that the water in the furrow should not overflow and submerge the crown of the beets. The furrows are usually about 3 or 4 inches deep. Different types of soil require different lengths of time for the application of the water in order to give the beets a thorough irrigation. Sandy lands require a quick run in order to be most efficient in the use of the water, while heavy soils which the water does not penetrate quickly require a long run of water. The farmer usually judges that the beets have sufficient water when the land is thoroughly saturated to the depth of an irrigating shovel in the middle of the strip between two water furrows. The length of time the water is run in the furrow depends greatly on the length of the row of beets. Many growers shut off the water as soon as it reaches the lower end of the furrow so as to avoid waste of the water from the ends of the rows.

Irrigating usually begins in the month of July, depending on the season, the amount of rains, and the size of the beets. The first irrigation water was applied to beets by 41 farmers of this group from July 5 to 15, 136 began irrigating from July 16 to July 25, 66 began irrigating from July 26 to August 5, and 5 did not apply the first irrigation until after August 6.

Six farmers applied the last irrigation to beets from August 1 to August 5, 14 finished irrigating from August 6 to 15, 83 finished from August 16 to 25, 75 applied the last irrigation from August 26 to September 5, 65 finished irrigating from September 5 to 15, and 5 irrigated beets as late as September 16.

The average length of time between the first and last irrigation of sugar beets was 37 days, while the extreme dates shown for individual irrigations range from July 5 to September 20, which gives a season of 77 days for irrigating.

Beets should not be irrigated until they are too large to cultivate and the leaves have spread out so that they will cover the ground

and shade it (fig. 6), so that the heavy crusts will not form in the furrows where the water has run. The beets are usually ready for irrigation about July 15 to 25. There is a popular belief that early irrigation tends to shorten the root of the beet, but this is not true where the beet is suffering for want of water. If the season is dry the farmer should not wait too long to irrigate. A beet should be kept in the best growing condition possible at all times and should not be allowed to lie dormant or have its growth checked when an application of irrigation water would make it grow rapidly. The

FIG. 6.—A flourishing field of sugar beets. When the beets cover the ground as shown in this picture, cultivation ceases.

season in this region is not long enough to permit part of it to be wasted by allowing the bets to stand still for lack of water. If beets are suffering from want of water and a rain comes, none of the farmers would think of its doing any harm to the bets, yet some were of the opinion that an irrigation would harm the beets.

After irrigation is begun, it is usually necessary to continue to irrigate every 10 to 20 days from the time of the first irrigation until about the first of September. To know how to irrigate, the grower must know his soil well, and he must study the condition of

his crop each year. The limit to the supply of available water must also be known, and the water must be so used that it will be properly distributed. The fact remains that the water must be used when it is delivered in the ditch. It may not always seem best for any given farm, but as there are many farms under the ditch each must take the water when it is available.

Irrigation usually proceeds day and night when the water is available, the average man putting in long hours in the operation. Some men turn the water on alfalfa fields at night, but most men set the water on long rows of beets and let it run all night. This sort of work demands that the water be set to running just before dark at night and changed as soon as day breaks in the morning. Many of the men stay in the field 14 or 15 hours a day when irrigating.

As already stated, irrigation is very distinctly an operation that is different for each farm. Some men can irrigate 5 or 10 acres per day and do it better, more efficiently, and easier than they could irrigate 2 acres on another farm. The head of water and the lay of the land cause part of this variation. It pays to irrigate carefully and not hastily. One should prepare his land so that there will be no low places where water will collect and stand.

The average labor cost of irrigation in the area studied is 61 cents per acre per irrigation; this means that the average man can irrigate about 4 acres in 12 hours. Four or five acres per day of about 12 to 15 hours can be covered when the water is running about all the time, day and night. The average man irrigated his beets 2.4 times; 26 men irrigated once, 168 irrigated twice, 89 irrigated three times, and 14 irrigated four times. The available data comparing the crop yields and the number of irrigations failed to show any manifest correlation. In order to form definite conclusions upon this subject, more detailed information as to time and number of water applications would be necessary, and types of soil and other considerations would have to be studied much more closely than was possible for the men gathering the data of this survey. Very little is known by the average farmer as to the quantity of water applied to each field or the quantity wasted, as he has no measuring devices for individual fields. The water is measured out of the main canal, but after that the farmer makes no accurate measurements.

These studies, made in 1915, show that detailed information was gathered from 301 farms upon which 8,745 acres of sugar beets were irrigated, the man labor expended upon each acre being 7.43 hours, at a cost of $1.49.

Four men did not irrigate their beets. These in all cases were beets on seeped or subirrigated lands. About 99 per cent of the total area planted to beets was irrigated. The nonirrigated lands of the

region are not adapted to the production of profitable crops of sugar beets.

LIFTING PRACTICE.

Nearly 91 per cent of the growers used 3-horse teams to lift beets, as they all used crotch 1-row lifters. None used 2-row or side-row lifters. Lifting is an arduous operation when the season is such that the fields become very dry; and it would seem that the different types of soil would make corresponding differences in the amount of labor necessary to lift the beets, but in this region it seems that the same number of horses is used in most cases. There is, however, a variation in the acres pulled per day by the crews of different farms.

It is not customary to keep the lifter going the entire day, as a man lifting with three horses can lift during the average 10-hour day 2.29 acres of beets. The average man has not enough horses to haul so many beets per day in addition to the lifting work, so the custom is to lift and pile and top only as many beets per day as can be hauled in a day. If beets lie in the field after being lifted or topped there is considerable loss in weight unless they are exceptionally well covered. Covering them over with leaves when they are in small piles will stop the evaporation to some extent, but the leaves soon wilt and are of little protection. Farmers try to avoid having to cover beets in the field.

On account of the danger of freezing, the farmers are always anxious to get all the beets out of the ground as soon as possible after harvesting begins, and this season is perhaps the busiest of the year. Beet pulling usually begins about the first of October and lasts until November. As a rule, November 5 is considered the latest safe date to have beets still in the ground. The men who get through early are usually hired by those with larger acreages. Very little other work is done after beet harvesting begins until the harvest is finished.

It required 4.41 hours of man labor and 13.09 hours of horse labor to lift the average acre of beets harvested, the average cost of the same being $2.18 per acre.

HAULING BEETS.

The hauling of the beets is one of the hardest operations in the production of the sugar-beet crop. The beets are always hauled when there is a rush to get work done, as there is danger of loss of beets if they are not harvested before the ground freezes. Harvest begins about October 1 and should be completed by November 5 to be safe from loss by freezing. In some seasons it is possible to

harvest after this date, but in other years the ground will be frozen so that it is very laborious or impossible to harvest the beets. Allowing for some wet or bad weather, it will be seen that beet harvesting is the rush season of the year.

Although labor at hauling beets is always paid a higher rate than other farm labor in this region, in estimating the cost of hauling the usual rate of 20 cents per hour for man labor and 10 cents per hour for horse labor is used as the basis in this bulletin. For hauling beets men get from $50 to $75 a month and board, according to the need the farmers have for labor.

Beets are hauled in special wagon boxes, which permit the beets to be dumped from the wagon directly into the cars that are to transport them to the factory. (Fig. 7.) The men do not have to shovel the beets when cars are available, but in many cases the number of

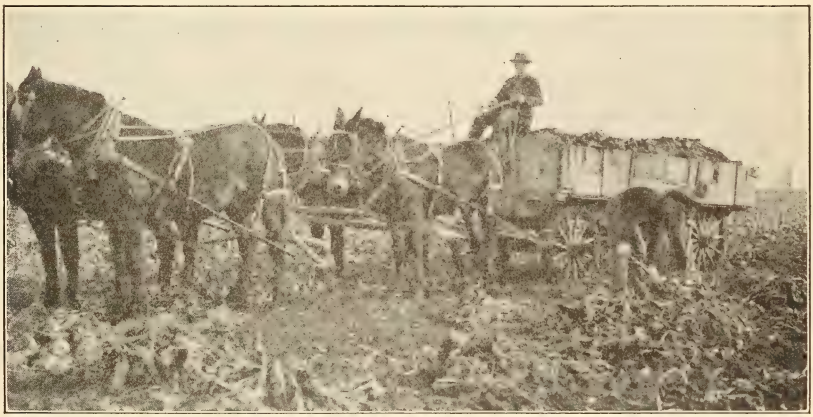

FIG. 7.—Loading and hauling sugar beets. Wagons are specially constructed to dump the load directly into a freight car or storage sheds.

beets harvested exceeds the quantity that can be stored at the factory, so the beets are piled at the dumps in large piles on the ground. Sometimes 5,000 tons are put into one pile. These piles are made about 8 feet high and of various widths and lengths. No extra compensation is provided for this piling of beets at the dumps.

Usually one man loads and unloads his beets at the dump, but in some cases the farmer has a man in the field who helps load the wagons, doing other work while the wagon goes to the dump.

These studies, made in 1915, show that detailed information with regard to hauling sugar beets was gathered from 305 farms, from which the product of 8,817 acres of beets was hauled, requiring an average of 10.36 hours of man labor and 29.66 hours of horse labor per acre. The cost of hauling was therefore $5.02 per acre, or 47 cents per ton.

The fact that hauling is done for less per ton with two horses than with other sorts of teams is perhaps not entirely due to the efficiency of this method of hauling, but is more likely to be due to the fact that the men with the uphill haul or harder haul used more horses to a wagon than the men with easier hauls. The cost of hauling varies with the season and the condition of the fields and roads. For 1915 the load hauled averaged 3.18 tons. Two horses hauled on an average 2.82 tons, three horses 2.92 tons, and four horses 3.37 tons, the average cost of hauling being 26 cents per ton per mile hauled, when man labor is figured at 20 cents per hour and horse labor at 10 cents per hour. If better methods of loading and unloading were devised, and especially if improvement could be made in loading beets on the wagons, this cost could be greatly lessened.

The hired hauling on an average cost 28.3 cents more per ton than hauling done by the farmer, where his labor was figured at $2 per day per man and $1 per horse for a 10-hour day, and the average distance for the hired hauling was 1.3 miles less. This gives some indication of the scarcity of labor which usually prevails during the harvest season. The man who has not the horses for hauling beets must hire the necessary men with teams and must have the labor done during a short period of time, so he has to pay for this work at a rate that is higher than is common for other seasons of the year. Usually he does not furnish wagons or any harness, which would mean some expense for wear and breakage. The average cost was $4.81 per acre for hauling the beets where the farmer did the work, counting labor only, and $7.85 for hired hauling, a difference of $3.04. In computing the cost of hauling 1 ton of beets 1 mile it was found that for farmers doing their own work in the first group, those averaging 0.76 of a mile, the average cost was 49 cents per ton-mile. For the second group, those averaging a 1.67-mile haul, the cost was 28 cents per ton-mile; in the third group, those averaging a 2.91-mile haul, the cost was 19 cents per ton-mile; in the fourth group, those averaging a 3.96-mile haul, the cost was 17 cents per ton-mile. The hired hauling cost 69 cents per ton-mile on an average haul of 0.88 mile, 51 cents per ton-mile for an average haul of 1.46 miles, and 36 cents per ton-mile for an average haul of 2.83 miles. The difference of 21 cents between groups 1 and 2 and 9 cents between groups 2 and 3 for farmers doing their own hauling might be taken as an indication that the average cost of loading beets was about 12 cents per ton; but this is not an accurate method of figuring, as the actual time taken to load the beets was not recorded. Table VIII, showing the cost of hauling according to distance, indicates that it costs the farmers in the group farthest from the dump an average of $3.11 more per acre to deliver their beets than those in the group closest to the dump.

In other words, the additional cost is about $1 per acre for each mile of distance from the dump. In the case of hired hauling this additional difference is more nearly $2 per acre for each mile from the dump.

TABLE VIII.—*Cost of hauling sugar beets in the Billings region of Montana in 1915.*

Classification.	Number of farms.	Beets hauled.	Average cost of hauling.	
			Per ton.	Per acre.
		Tons.		
Hauled by grower:				
Less than 1½ miles (average 0.76 mile)	112	39,220	$0.37	$3.98
1½ to 2½ miles (average 1.67 miles)	100	29,544	.463	4.98
2½ to 3½ miles (average 2.91 miles)	65	18,337	.544	5.85
3½ miles and farther (average 3.96 miles)	12	3,788	.659	7.09
All farms [1] (average 2.86 miles)	289	90,899	.447	4.81
According to the size of the crew:				
1 man, 2 horses	120	34,897	.402	.....
1 man, 3 horses	30	8,521	.498	.....
1 man, 4 horses	118	37,859	.46	.....
3 men, 8 horses	11	5,021	.52	.....
Mixed	10	4,591	.52	.....
Total [1]	289	90,889	.447	.....
Hired hauling:				
Less than 1½ miles (average 0.88 mile)	4	847	.61	6.56
1½ to 2 7/16 miles (average 1.46 miles)	12	3,888	.75	8.07
2½ to 3 7/16 miles (average 2.83 miles)	3	137	1.00	10.76
All hired (average 1.55 miles)	19	4,872	.73	7.85

[1] Excluding 19 farms from which the hauling was done under contract, as shown in the last part of the table under "Hired hauling."

HAND OR CONTRACT LABOR.

The labor on the sugar-beet crop that is done by hand without the use of machinery consists of blocking, thinning, two hoeings, and pulling, piling, and topping the beets. About three-fourths of this labor in the Billings region is done by contract. The labor contractors make an agreement with the farmer to do all the handwork on the crops, receiving therefor a definite sum under a system which makes it to the interest of the contractor to cover as large an acreage as possible per day. Some growers try to counteract the tendency toward careless work by paying a bonus to the workers if the beets yield more than a certain tonnage per acre. This bonus system is not in general use, not having reached any definite or satisfactory basis, but it has features which recommend it. The basis now varies according to the different ideas as to what it should be.

In cases where there is any disagreement, the factory agricultural force supervises and looks after the fulfillment of the contracts between the farmers and the laborers. Most of the contract laborers in this region are Russians or Belgians.

A great deal of this work is done by the children of the families of the men doing the hand labor. Women also are employed in the

fields at this work. The work of thinning, which requires the worker to stoop or crawl along the beet row, is performed by boys or girls about 15 years of age, in many cases more efficiently than by men. In figuring the costs for this labor, children who are able to do full work have been allowed the same rate per hour for labor as men. All the labor is estimated on the basis of what a man can do per day. There is no indication that men who do their own beet thinning get better crops than those who have the thinning done under contract.

Of the 305 farms in the entire study, on 227 farms a whole or part of the hand labor was contracted for at a definite rate per acre for the work. The area worked in this manner was 6,399 acres, at a cost to the farmer of $18.53 per acre for all hand labor, which includes thinning, hoeing, topping, etc. On 91 acres the contract was for blocking and thinning only, at an average price of $6.89 per acre. On 123½ acres the contract was for piling and topping only, at an average cost of $9.14 per acre. There were no farms where hoeing was contracted for as a separate operation. (Table IX.)

TABLE IX.—*Average requirements and cost per acre of hand labor on the sugar-beet crop in the Billings region in 1915.*

[Hand labor is figured at 20 cents per hour.]

Kind of work.	Labor done by grower.		Labor contracted.		Average for each acre planted.	
	Hours.	Cost.	Hours.	Cost.	Hours.	Cost.
Blocking and thinning	36.9	$7.38	30.9	$6.18	32.25	$6.45
First hoeing	15.5	3.09	10.3	2.06	11.5	2.30
Second hoeing	7.9	1.59	5.15	1.03	5.8	1.16
Pulling and topping	36.5	7.30	46.30	9.26	43.65	8.73
Total	96.8	19.36	96.65	19.53	93.2	18.64

The general impression in the Billings region is that the contract laborers get a good price for the work of thinning, topping, etc., but the good daily wage is due largely to the fact that they work rapidly so as to complete the thinning before the beets are very large, and that they work very long days. The thinner averages from 12 to 14 hours per day; this is especially true of the contract laborers. Some of these workers become very expert, being able to block and thin an acre of beets in two days; some even exceed this rate.

Growers who do their own hand labor are in most cases men who have large families and who have had experience as contract beet workers. They are usually of foreign birth. It is very common for a man to come into the region and work a few years as a contract laborer and then rent or buy a farm and begin to work for himself. These men who are successful in saving enough money to begin farming for themselves are usually the most industrious of the contract laborers. Having had experience in handling the crop, they usually grow rather large acreages of beets.

COST OF SEED FOR SUGAR BEETS.

The seed for the sugar-beet crop is furnished to the farmer by the sugar company contracting for the beets. This seed has been sold to the farmers at 10 cents per pound for a number of years, and the quantity of seed per acre is often specified. Most farmers plant the amount per acre that the company specifies; therefore the cost per acre for seed runs very nearly the same for each farm. The cost of seed per ton of beets produced is very variable, as there is variation in the tonnage per acre. For individual farms the cost of seed per ton of beets produced varied from 10 cents to more than 60 cents. Detailed information gathered from 305 farms growing 8,849 acres of beets is as follows: Pounds of seed per acre, 17.2; cost of seed per pound, 10 cents; cost of seed per acre, $1.72; cost of seed per ton of beets produced, 16 cents.

COST OF MACHINERY.

The cost of machinery varies greatly in accordance with the amount of machinery the man owns and the area of beets that he cultivates. Some growers had high-priced machinery and a small area in beets, so the cost of machinery per acre ran very high; in some instances it was more than $15 per acre. To grow a crop of beets, a farmer should own the machinery or be able to rent certain machines when needed. To own all machinery is not always advisable where the area in beets is less than 10 acres.

The depreciation of machinery on various farms varied from 10 to 25 per cent of the original value, depending on the acreage of beets to be tended by one machine and the type of machinery owned. The grower should either own or have the use of the following machinery: Plow, harrow, level, beet drill, beet cultivator, beet wagon (with box of a special type for the automatic dumping of the beets), beet puller, hoes, shovels, topping knives, and beet forks. In some cases a roller and a manure spreader should be added to this equipment.

It is rather hard to get an exact figure for the cost of machinery for beets, as farmers use the same wagons, harrows, plows, etc., on other crops, and allowance for this has to be made; but it is possible to get a reasonably accurate estimate of the depreciation and repair cost of machinery that is chargeable to beets by comparing the acreage in other crops. These charges were figured separately for each farm, and Table X shows the results of the data furnished by 305 farmers as to the costs chargeable to the sugar-beet crop for the use of machinery.

Table X is necessarily more or less of an approximation, and there may be some items of cost not enumerated; however, the costs were

obtained in a manner which should include the correct total cost of machinery for beets during the season of 1915.

TABLE X.—*Cost of machinery for growing sugar beets in the Billings region in 1915.*

Items of cost.	Total.	Per farm.	Per acre.	Per ton of beets.	Percentage charge.
Repairs	$5,671	$18.59	$0.64	$0.06	24.2
Depreciation	10,393	34.08	1.17	.11	44.3
Interest on investment at 8 per cent	6,678	21.89	.76	.07	28.8
Hired machinery	637	2.09	.07	.01	2.7
Total cost	23,379	76.65	2.64	.25	100.0

PRORATING INTEREST ON THE INVESTMENT.

Detailed information covering the cash investment in 305 farms on which 8,849 acres of sugar beets were grown showed an average of $3,656 per farm, and the prorated interest cost chargeable to the beet crop was $11.99, being an average of 41 cents per acre planted to beets and 4 cents for each ton of beets produced.

The average man pays about 41 cents per acre for interest on money invested in the beet crop. This is only for money spent for labor and miscellaneous items of cost, the greater part being for money paid to contract laborers or hired labor. Contract laborers receive about half of their contract price at a time soon after the blocking and thinning is done. For this region this averages about $9 per acre, and in most instances it is paid some time in June or July, although in some cases it is advanced to the laborer earlier in the season. No money is received from the beet crop until October or November, so the interest on money paid for hand labor runs for four to six months.

Interest on contract-labor money for four to six months at 8 per cent for $9 is 24 cents to 36 cents per acre, depending on the time the contractor receives the money. Interest on money paid to the farm laborers for one to eight months, depending on the number of laborers hired, varies on different farms from nothing to 60 cents per acre of beets grown.

COST OF LAND FOR SUGAR BEETS.

The owner's cost for land is divided between interest, irrigation water, and other items that are furnished by landlords on rented farms. These items aggregate $11.99 per acre, divided as follows: Interest on real estate, $9.86; land taxes, $1.15; cost of water for irrigation, 86 cents; miscellaneous charges, 12 cents. (Table XI.)

TABLE XI.—*Apportionment of interest, taxes, and charges for irrigation water for growing sugar beets on rented lands and owned farms in the Billings region.*

Classification of farms.	Number of farms.	Acres of beets.	Cost for land.		
			Total.	Per acre.	Per ton.
All farms	305	8,849	$104,931	$11.85	$1.10
Beet lands:					
Cash-rented		1,620	15,226	9.25	.85
Share-rented		3,801	49,071	12.91	1.28
Owned		3,428	41,098	11.99	1.04

The charges pertaining to owned lands are figured on the estimated value of the land planted to beets, with interest at the rate of 8 per cent. Lands under cash rentals are figured on a similar basis as to the value of the land in beets and the value of other lands on the farm, so as to charge the proper amount for beet lands. Lands under share rentals are figured on the basis of the value of the share of beets and beet tops that the landlord receives. This may be a little high when considered from the basis of the landlord's expectation that the beet-land rental will bring up the average rental of the farm which has a considerable acreage in grains and hay, on which a less rental per acre is paid to the landlord. The usual share of the beets paid for rental is one-fifth of the crop, and in many cases the landlord requires that a certain acreage of land be planted to beets. The tops are divided in various ways, there being no prevailing method as to the division.

Share renters on a few farms gave the landlord as much as one-half of the crop for rental; but in all of these cases the extra rental was for some special expense borne by the landlord, such as furnishing seed, part of the contract labor, a supply of manure, or the equipment and work stock. Under such conditions allowances were made for these extra items furnished, and this amount is properly deducted from the landlord's total charge, as the tenant in such cases is giving part of the crop for something else than the land on which to grow it, and the landlord is paying other expenses than those properly called land charges. These special rentals are not common, and in most cases the landlord, being responsible for the success of the crop, usually demands a good return for his investment. The tenants on such farms are often men who have very little capital, and they would be unable to handle farms of any size unless provided with some outside capital.

Cash rentals are much lower than the share rentals, owing to the small risk taken by the landlord, who is certain of a definite income from the farm; but the landlord who rents land for a share of the

crop does not get much if the farm is badly handled or if the crops are poor from any cause. Most of the cash-rented farms are owned by absentee landlords, while many of the share-rented farms are owned by farmers who live in the region and can supervise their farms to some extent.

The average value of the owned beet lands is $123.60 per acre, and with interest at 8 per cent this item is by far the heaviest in the list of costs of land for beets. The valuation given for share-rented lands was $126.91 per acre and for lands that were rented for cash the value was given as $134.19. These values are based upon the sale value as estimated by the man operating the farm. The average value of all sugar-beet land studied in the Billings region was $126.95. Assuming that the cost of water for irrigation and the cost of taxes and miscellaneous items are the same for landlords as was found for owners of beet lands (a total of $2.13 for these items), the landlords of the region have an average of $7.36 per acre for interest on cash-rented lands and $11.98 for interest on share-rented lands. This amounts to interest at 5.5 per cent on the value as given per acre for cash-rented lands and interest at 9.4 per cent on the value of share-rented lands.

RELATION OF YIELDS TO COST AND PROFIT.

Seemingly there is the most profit in a crop of beets of about 14 tons or over per acre in the Billings region. The average profit per acre, as shown by this study, is the same for yields of more than 14 tons, but this should not be taken to indicate that to increase the yields on this land so as to produce more than 14 tons is to incur an expense that may not return a profit over and above the cost of the extra labor. High yields per acre seem to be associated with higher profits per acre. Most growers getting large yields are men who use much manure on their beet lands, and it is not correct to state that they do not get a profit on increasing the yields, as they find employment during a time they might otherwise be idle and have idle teams. In figuring the cost, allowance has been made for the yard value of the manure and regular prices paid for labor. The labor which is done in the winter and early spring is profitable, as no profit would otherwise be shown. Horse labor especially will show a profit, as the teams would cost about the same for keeping whether they were worked or not, and usually the work is not hard. To disregard these facts and figure on the actual cost might warrant the conclusion that increased yields are not profitable. It would be difficult to give any definite yield as the limit of profitable attainment, but it is reasonable to assume that it is higher than any of the yields produced, and perhaps many tons higher. The growers

who showed a loss on beets yielding over 12 tons per acre were only three in number and grew only small areas, averaging less than 6 acres each. Each had used heavy applications of manure and had given it a value of $1 per ton in the yard; the investment in machinery was also high in each case. The average cost for their machinery was nearly $12 per acre, while the average for the region was $2.64 per acre. Unless land is capable of yielding better than an 8-ton crop of beets it is advisable not to plant beets on it, but to plant some crop that will not require so much labor for production. Cheap and poor lands are not adapted to beets or any crop that requires much labor per acre. The only case where a man can afford to grow beets on land that does not produce well is where he owns the land and is trying to eradicate weeds by careful cultivation. He must have some return other than that received from the beet crop. If the grower is willing to work for less than the price figured in this bulletin as the cost of growing beets or is an exceptional manager of labor he can make a return from a beet crop that is less than 8 tons an acre, but it is an uncertain speculation. It is admitted, however, that there are many exceptions and that some men can show a profit from a small yield, as they are growing the beets at a time when they would otherwise be unemployed. Beets afford a means whereby the farmers of this region are able almost to double the length of the season that they have field work to do, for there is no other common row-tilled crop, and hay and grain farming does not afford labor early in the summer at beet-cultivation time or late in the autumn when beets are to be harvested. A farmer's profits often depend on the length of the season of crop labor. There is no doubt that on a larger area the cost per acre for machinery would average less, as the investment total would need to be no larger. If these men were able to pay for labor and get a return for the manure used, there is no doubt that their loss is only a figurative one. If they had allowed only 50 cents per ton for the yard value of manure they would have shown a profit on their beets, as the average loss per acre was very small.

A few growers made a small profit per acre on beets that yielded about 8 tons per acre, and one that had a yield of 7 tons made a small profit. None of these men had any charge for manuring, and most of them were share renters. All reported rather rapid work and did not go over the ground a very great number of times. More than half of them did their own hand labor and reported doing it at a rapid rate, and the charge for hand labor in some of these cases was not over $12.50 per acre. These men show that in rare instances where the land is not hard to handle and the man works very rapidly it is possible to show a profit on beets that yield 8 tons per acre, but this is not possible in most cases and not possible on small areas

where the fields are small and there is much turning to do. Few of these men had small areas, their average acreage being above 30.

The average yield per acre on the 305 farms covered by this study was 10.76 tons, and the information gathered indicates that a yield of 8.87 tons per acre is required in order to pay expenses. There was a loss on 2,019 acres (22.8 per cent of the total acreage) and a profit on 6,830 acres (77.2 per cent of the total acreage). (Table XII.)

TABLE XII.—*The cost and profit from sugar beets as related to yields per acre and to acreage per farm in the Billings region in 1915.*

Classification.	Percentage of total acreage.	Per acre.		Per ton.		Percentage of acreage showing a profit.
		Cost.	Profit.	Cost.	Profit.	
Yields per acre:						
4 tons and less	1.71	$43.13	—$19.66	$12.59	—$5.74	None.
4.1 to 5 tons	3.14	45.18	— 12.66	9.20	— 2.56	Do.
5.1 to 6 tons	3.76	46.91	— 7.20	7.87	— 1.21	Do.
6.1 to 7 tons	3.54	51.36	— 5.90	7.46	— .86	1
7.1 to 8 tons	8.53	51.52	— .56	6.50	— .07	57.7
8.1 to 9 tons	8.59	55.85	1.45	6.26	.16	66.1
9.1 to 10 tons	13.39	55.87	6.58	5.64	.66	77.3
10.1 to 11 tons	11.90	56.07	12.84	5.14	1.18	96.8
11.1 to 12 tons	17.30	59.93	16.34	5.00	1.36	99
12.1 to 13 tons	11.63	58.61	23.48	4.58	1.83	100
13.1 to 14 tons	6.35	60.47	28.15	4.32	2.02	97.7
14.1 to 15 tons	7.13	65.40	28.55	4.36	1.91	100
15.1 to 16 tons	2.40	64.64	33.95	4.06	2.13	100
16.1 tons or more	.63	77.10	30.91	4.55	1.83	92.6
Total	100	56.79	11.70	5.28	1.08	77.2

Classification.	Average area.	Number of farms.	Per acre.			
			Yield.	Value.	Cost.	Profit.
Area in beets per farm:	*Acres.*		*Tons.*			
5 acres or less	4.6	10	11.7	$74.80	$74.46	$0.34
6 to 10 acres	8.7	37	10.3	66.83	60.95	5.78
11 to 15 acres	13.2	26	10.8	69.08	62.21	6.87
16 to 20 acres	18.1	41	10.4	66.17	58.12	8.05
21 to 30 acres	26.0	79	10.7	68.82	55.63	13.19
31 to 40 acres	36.6	59	10.8	68.76	56.48	12.28
41 to 50 acres	46.2	27	11.0	70.10	56.18	13.92
51 to 60 acres	55.5	11	10.8	67.33	53.94	13.39
Over 60 acres	88.6	15	10.5	67.19	55.82	11.37
Total	29.1	305	10.76	68.49	56.79	11.70

Table XII indicates that the acreage of beets per farm had little to do with the yield per acre but had much influence as to the profits per acre within certain limits. It appears that each farmer should plant at least 20 acres of beets in order to have them grown most economically. Above 20 acres there seems to be but slight variation in the cost of production or profits per acre.

SUMMARY.

(1) The data gathered from 305 farms in the Billings region of Montana give the total hours of labor required to produce beets and the other costs of production for the season of 1915. (Table XIII.)

TABLE XIII.—*Summary of labor requirements for the production of sugar beets.*[1]

[Man labor is rated at 20 cents per hour and horse labor at 10 cents per hour.]

Kind of labor.	Average per acre worked.			Average per acre of all sugar beets studied.		
	Cost.	Man.	Horse.	Cost.	Man.	Horse.
Farm labor:		*Hours.*	*Hours.*		*Hours.*	*Hours.*
Manuring	$3.31	8.90	15.30	$1.21	3.27	5.59
Plowing	2.54	4.59	16.18	2.90	5.23	18.55
Crowning alfalfa	2.48	4.35	16.14			
Disking	1.09	1.84	7.19	.23	.39	1.52
Rolling land	.29	.71	1.49	.08	.20	.41
Floating	.89	1.31	5.96	.87	1.47	5.80
Harrowing	.93	1.75	5.75	.93	1.75	5.75
Cleaning ditches	.13	.32	.61	.12	.32	.60
Planting seed	.40	1.00	2.00	.40	1.00	2.00
Rolling	.31	.77	1.55	.17	.43	.86
Cultivating	1.74	4.46	8.46	1.74	4.46	8.46
Furrowing	.39	1.00	1.89	.39	1.00	1.89
Irrigating	1.49	7.43	.....	1.47	7.34	.....
Lifting	2.18	4.41	13.09	2.18	4.41	13.09
Hauling	5.12	10.36	29.66	5.02	10.36	29.66
Total	23.19	53.40	125.27	17.71	41.76	94.18
Hand labor:						
Blocking and thinning	.....	.....	.....	6.45	32.25	.....
Second hoeing	.....	.....	.....	2.30	11.50	.....
Third hoeing	.....	.....	.....	1.16	5.80	.....
Pulling and topping	.....	.....	.....	8.73	43.65	.....
Total	.....	.....	.....	18.64	93.20	.....

[1] In the columns headed "Average per acre worked" are given the average cost and labor expended on each acre for each operation, computed on the number of acres covered by each operation. In the columns under "Average per acre of all sugar beets studied" the total surveyed acreage (8,849) is the basis of computation.

The aggregate of overhead charges for the entire area was $20.44 per acre, divided as follows: Land charges, $11.85; manure, $3.79; machinery, $2.64; seed, $1.72; cash to run farm, 41 cents; miscellaneous, 3 cents.

The total cost of sugar-beet production as herein shown is $56.79 per acre, divided as follows: Farm labor, $17.71; hand labor, $18.64; overhead costs, $20.44.

The grower can apply these data to the present requirements by adjusting them to the present prices of labor, real estate, equipment, and the value of beets produced. There have been no changes of note in the labor requirements of production.

(2) The information obtained indicates that the growing of sugar beets can not be profitable in this region unless a yield of more than 8 tons of beets per acre is produced. It is also shown that each farmer should grow at least 20 acres for most economical production.

(3) Of the total area in sugar beets, 77.2 per cent of the acreage was grown at a profit.

(4) The average acre of the region devoted to sugar beets returned a profit of $11.70 after paying the cost of production.

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